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"Effectiveness Of Isometric Neck Exercises Versus Pressure Biofeedback Neck Exercise In Case Of Cervical Spondylosis"

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Abstract:
Background*: Cervical spondylosis is a degenerative condition of the spine associated with aging. It involves degenerative changes in the intervertebral disc, leading to reduced disc height and capacity to bear axial loads along the cervical spine. This can lead to compression of neural and vascular structures. The aim of this study is to compare the effectiveness of isometric neck exercises versus pressure biofeedback neck exercise on the pain and function in cervical spondylosis.*
Materials and Methods*: A randomized controlledtrial was performed on 50 subjects (both gender) divided into 2 equal groups with age group 30-60 years with diagnosis of Cervical spondylosis. Group A subjects received Isometrics along with TENS for 3 weeks. In group B, subjects received Pressure Biofeedback along with TENS. Data was collected Pre-intervention (Day 1), 2nd week (midterm) and at the end of 3rd week (post-test), for outcome measures of pain on VAS Scale and functional ability on NDI.*
Results*: Results suggested that both form of exercises are effective in relief of pain & improvement in function but patients in Group B, which were given Pressure biofeedback along with TENS demonstrated more improvement in achieving pain relief and function as compare to group-A.*
Conclusion: *Both exercise regimens resulted in significant improvements in NDI and VAS from baseline to 3 weeks. However, the pressure biofeedback group demonstrated superior outcomes compared to the isometric group, with greater reductions in NDI and VAS scores.*
Key Word: *Isometric neck exercises; Pressure Biofeedback; TENS; Cervical spondylosis; VAS, s NDI.*

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I. Introduction

Cervical spondylosis is a prevalent and progressive degenerative condition of the human spine, primarily resulting from the natural aging process. It is associated with degenerative changes within the intervertebral disc, leading to disc desiccation. This results in a decrease in overall disc height and a reduced disc capacity to maintain or bear additional axial loads along the cervical spine. [1]

The pathogenesis of cervical spondylosis involves a degenerative cascade that produces biomechanical changes in the cervical spine, manifesting as secondary compression of neural and vascular structures. An increase in the keratin-chondroitin ratio prompts changes to the proteoglycan matrix resulting in loss of water, protein, and mucopolysaccharides within the intervertebral disc. Desiccation of the disc causes the nucleus pulposus to lose its elasticity as it shrinks and becomes more fibrous. As the nucleus pulposus loses its ability to maintain weight-bearing loads effectively, it begins to herniate through the fibers of the annulus fibrosus and contributes to the loss of disc height, ligamentous laxity, and buckling, and compression of the cervical spine.

Most individuals with spondylotic changes in the cervical spine identified through radiographic imaging do not exhibit symptoms. Studies show that these degenerative changes are present in 25% of people under 40, 50% of those over 40, and 85% of individuals over 60.

According to the Global Burden of Disease 2015 study, low back and neck pain continue to be the primary cause of years lived with disability (YLD) and rank as the fourth leading cause of disability-adjusted life years (DALYs). [2]

Numerous studies have shown that repetitive movements, prolonged poor neck posture, age-related degeneration, and forward head posture can lead to mechanical compression of the cervical spine. [3]

Cervical spondylosis can present in several clinical forms: neck pain marked by stiffness and discomfort exacerbated by movement, cervical radiculopathy showing as unilateral or bilateral neck and arm pain, tingling, and weakness following specific nerve patterns, and cervical myelopathy, initially causing hand weakness, clumsiness and impacting tasks requiring fine motor coordination. [2]

Currently, various therapeutic strategies are employed to manage cervical spondylosis and alleviate associated pain and disability. Evidence suggest that exercise therapy is effective in reducing neck pain and improving functional outcomes in patients with Cervical spondylosis.

Isometric exercises, also known as static exercises, effectively strengthen weakened muscles by causing muscle contraction without changing the length of the muscle or moving the joints involved. [4]

Stabilizer pressure biofeedback is crucial for enhancing motor learning in affected muscles through visual feedback. It aids in strengthening muscles, improving stabilization, and alleviating. [5]

The analgesic effect of tactile stimulation constitutes the rationale for using Transcutaneous Electrical Nerve Stimulation (TENS), the delivery of electrical stimuli that activate peripheral somatosensory afferents, to relieve both acute and chronic pain. [6]

Only few studies have been done to evaluate the efficacy of isometric neck exercises Versus Pressure Biofeedback neck exercise in case of Cervical Spondylosis Therefore, the purpose of this study is to compare Effectiveness of isometric neck exercises Versus Pressure Biofeedback neck exercise in case of Cervical Spondylosis.

II. Material And Methods

A sample of 50 subjects both male & female with a diagnosis of cervical spondylosis were referred to Physiotherapy OPD of Mahatma Gandhi Hospital, Jaipur by the ortho and neuro department. Subjects were randomly assigned into two groups i.e. 25 subjects in each group. Informed consent of subjects was taken before the participation for this study. As per international standard or university standard written ethical approval has been collected and preserved by the author(s). Subjects who fulfilled the inclusion criteria were selected for this study. The study's inclusion criteria require participants to be between 30 and 60 years old, with an NDI score above 15/50, and clinical findings of cervical spondylosis. They should not have surgical indications and should not have received exercise therapy or physiotherapy in the 6 weeks before the study. The exclusion criteria prohibit individuals with specific conditions, such as cervicogenic headache, neck trauma, vertebrobasilar artery insufficiency, thoracic outlet syndrome, shoulder disorders, or cervical fracture, from participating in the study.

In this study, pain was measured using the visual analogue scale, where subjects were presented with a 10-centimeter line with "0" representing no pain and "10" representing the maximum pain. They were then asked to mark their level of pain along this scale. Additionally, the Neck Disability Index was used, consisting of 10 items related to daily activities, pain, and concentration. Participants scored each item from 0 to 5, and the total score was expressed as a percentage, with higher scores indicating greater disability. [7,8]

Procedure

A total of 50 Participants were randomly divided into two groups. In Group A: All 25 patients were treated by providing isometric neck exercises. In Group B: all 25 patients were treated with Pressure Biofeedback Neck Exercises. Transcutaneous electrical nerve stimulation (TENS) was common in both groups

Group A (Isometric neck exercises + TENS)

- **Neck isometrics**
  - Neck isometric strengthening exercises was given to the Subjects of Group A for 6 days in a week for initial 3 weeks under supervision. Each set consisted of 6 movements (Cervical flexion, cervical extension, Right Lateral Flexion, Left Lateral Flexion, Right Rotation, and left rotation) holding each movement for 10 seconds, and repeating every 5 times with a 5-second rest between each of them. [4]
- **Transcutaneous electrical nerve stimulation (TENS) -** was given on a painful area for 6 days a week for an initial 2 weeks with Frequency 5Hz, Intensity high, Pulse duration: 300 Micro sec., Duration: 20 minutes, Electrode placement: Area of greatest intensity of pain. [9]

Group B (Pressure Biofeedback Neck Exercises + TENS)

- Pressure Biofeedback neck exercises were performed 6 days a week for 3 consecutive weeks, holding each movement for 10 seconds, and repeating each 10 times.
- Training of Deep Neck Flexors using stabilizer pressure biofeedback: Patient lies supine with the head and cervical spine in neutral position. The 3 folded pressure cell was positioned under the neck so that it abuts against the occiput and reading should be checked to maintain it in 20 mm Hg. The movement patient was asked to perform was gentle nodding of the head, as if they were saying 'Yes'. The patient were instructed to

gently nod and just one mark on the pressure dial and see if the patient can hold the position steadily. Then successful relax and repeat at each target position up to 30 mm Hg, hold for 10 sec breathe normally. [10, 11]

- **Transcutaneous electrical nerve stimulation (TENS)-** was given on a painful area for 6 days a week for initial 2 weeks with Frequency 5Hz, Intensity high, Pulse duration: 300 Micro sec., Duration: 20 minutes, Electrode placement: Area of greatest intensity of pain. [9]

Statistical Analysis

Outcome measures of all the individuals were analyzed at baseline before the start of therapy, at the end of 2nd week, and at the end of 3rd week, i.e., the end of therapy. A comparison between the twogroups was done on the Unpaired T-test. SPSS statistical software was used for data analysis.

III. Result

In this study, the mean age of Group A was 41.77 ± 6.93 and that of Group B was 42.57 ± 6.92 years (Table 1). There is no significant difference in mean age between the selectedgroups.
In this study Unpaired t- test was used for both the variables, namely VAS & NDI score.

Intergroup Analysis of VAS Score

Table 1. Demographic profile Isometric & Pres. Biofeedback VAS

Demographic			Isometric + TENS			Pres. Biofeedback + TENS	
			Mean	SD		Mean	SD
Age			41.77	6.93		42.57	6.92

Table 2. Comparison of mean value along with standard deviation, t value and p-value for both groups Isometric and Pres. Biofeedback

Groups	**VAS**	**Mean**	**SD**	**N**	**T Value**	**df**	**P value**
Isometric + TENS	Baseline VAS	7.72	0.83	25		24	<0.001
	2nd Week VAS	6.71	0.83	25	9.59	24	
	3rd Week VAS	5.63	0.94	25	13.33	24	
Pres. Biofeedback + TENS	Baseline VAS	7.91	0.89	25		24	<0.001
	2nd Week VAS	5.08	0.67	25	4.5	24	
	3rd Week VAS	3.05	0.67	25	3.5	24	

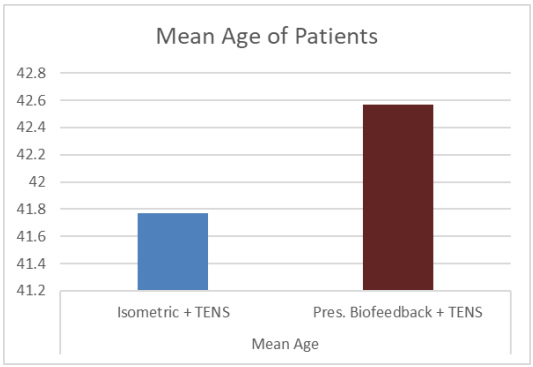

Fig. 1. Comparison of VAS with isometric + TENS and VAS with Pres. Biofeedback + TENS age mean value

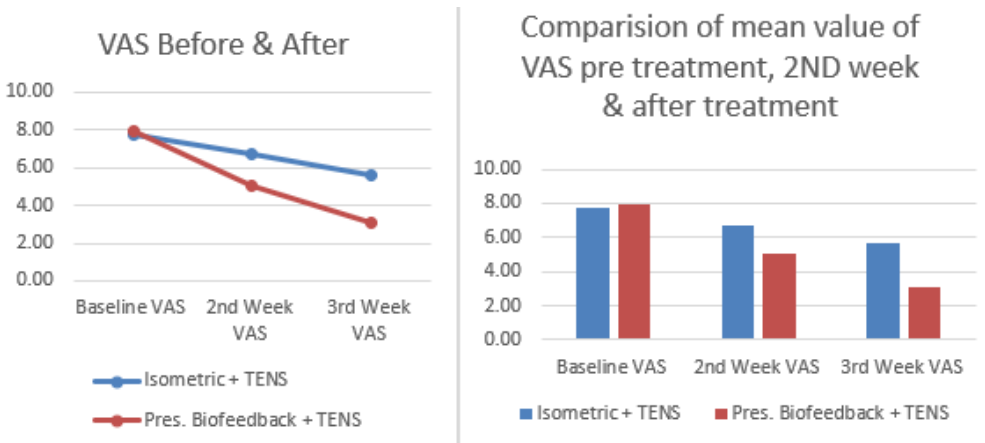

Fig. 2. Inter-group analysis of VAS Score

There was no significant difference in VAS with isometric + TENS and VAS with Pres. Biofeedback + TENS on VAS score (M=7.72, SD = 0.83) on 1st day t (19) = -13.33, p > 0.05 < 0.1. In the of 2nd week there was significant difference between VAS with isometric + TENS (M =6.71, SD =0.83). At the end of 3rd week there was significant difference between VAS with isometric + TENS (M =5.63, SD =0.94) and VAS with Pres. Biofeedback + TENS (M=7.91, SD =0.89) in VAS score t (19) = 3.5, p < 0.001. In the of 2nd week there was significant difference between VAS with Pres. Biofeedback + TENS (M=5.08, SD =0.67). At the end of 3rd week there was significant difference between VAS with Pres. Biofeedback + TENS (M =3.05, SD =0.67). Therefore, there is more improvement in VAS with Pres. Biofeedback + TENS in comparative to VAS with isometric + TENS.

Intergroup Analysis of NDI Score

Table 3. Demographic profile Group Isometric & Pres. Biofeedback NDI

Demographic	Isometric + TENS			Pres. Biofeedback + TENS	
	Mean	SD		Mean	SD
Age	41.77	6.93		42.57	6.92

Table 4. Comparison of mean value along with standard deviation, t value and p-value for both groups Isometric and Pres. Biofeedback

Groups	NDI	Mean	SD	N	T Value	Df	P value
Isometric + TENS	Baseline NDI	27.81	2.88	25		24	<0.001
	2nd Week NDI	23.84	2.41	25	2.6	24	
	3rd Week NDI	20.70	2.41	25	3.3	24	
Pres. Biofeedback + TENS	Baseline NDI	29.32	2.74	25		24	<0.001
	2nd Week NDI	24.29	2.74	25	5.1	24	
	3rd Week NDI	19.19	2.63	25	2.2	24	

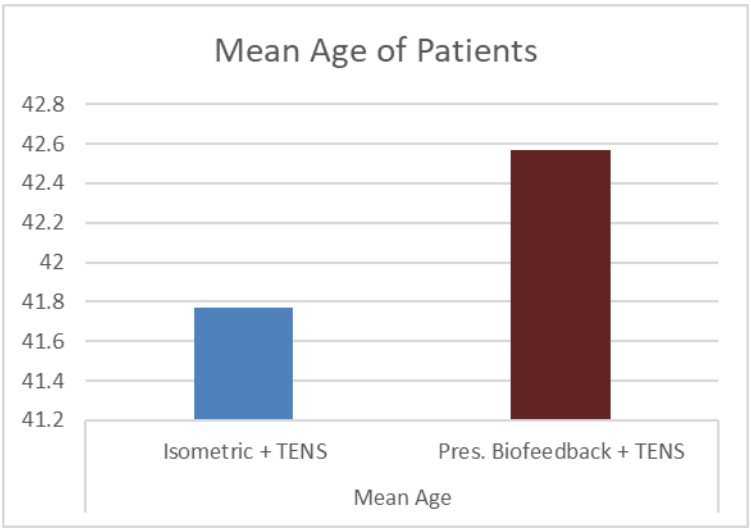

Fig. 3. Comparison of NDI with isometric + TENS and NDI with Pres. Biofeedback + TENS age mean value

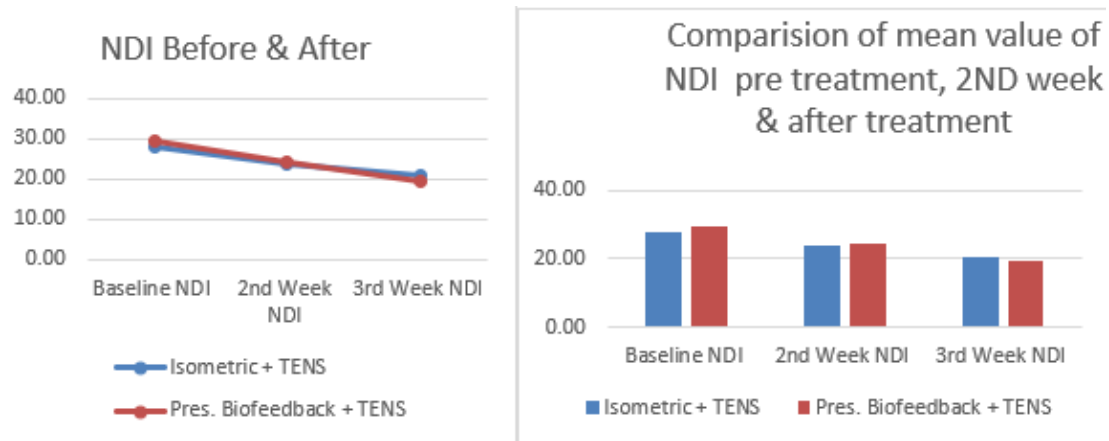

Fig. 4. Inter-group analysis of NDI Score

There was no significant difference in NDI with isometric + TENS and VAS with Pres. Biofeedback + TENS on NDI score (M=27.81, SD = 2.88) on 1st day t (19) = -3.3, $p > 0.05 < 0.1$. In the of 2nd week there was significant difference between NDI with isometric + TENS (M =23.84, SD =2.41). At the end of 3rd week there was significant difference between VAS with isometric + TENS (M =20.70, SD =2.41) and VAS with Pres. Biofeedback + TENS (M=29.32, SD =2.74) in VAS score t (19) = 2.2, $p < 0.001$. In the of 2nd week there was significant difference between VAS with Pres. Biofeedback + TENS (M=24.29, SD =2.74). At the end of 3rd week there was significant difference between VAS with isometric + TENS (M =19.19, SD =2.63). Therefore, there is more improvement in NDI with Pres. Biofeedback + TENS in comparative to NDI with isometric + TENS.

IV. Discussion

Following the 3 weeks of exercises, a significant reduction in pain and perceived disability, as measured by the VAS and NDI, was identified for both training groups. Upon Inter-group analysis of mean difference in the improvement of pain on VAS and function on NDI, the result shows that in both Groups VAS Score and NDI Score decrease but it decreases in Pressure biofeedback along with TENS group in comparison to Isometrics.

Cervical spondylosis is associated with degenerative changes within the intervertebral disc where desiccation of the disc occurs, thus causing overall disc height loss and a reduction in the ability of the disc to maintain or bear additional axial loads along the cervical spine which leads to Neck pain, cervical radiculopathy, neck, subscapular, or shoulder pain, accompanied by shock sensations and numbness in the extremities. [1]

In the study by Alireza Sadeghi et.al in 2022 concluded that there are several therapeutic approaches for the management of cervical spondylosis and its associated pain and disability. Evidence indicates that exercise therapy is effective in alleviating neck pain and reducing disability in patients with cervical spondylosis. [4]

According to an randomized controlled trial by Alpayci et.al in 2017 demonstrates the efficacy of isometric neck extension exercises in restoring the natural curve of the cervical spine and in alleviating neck pain. This suggests that such exercises can be a beneficial addition to the treatment regimen for patients suffering from loss of cervical lordosis and associated neck pain.[12]

Metanalysis done on the Effects of isometric training on the treatment of patients with neck pain by Jiaqi Yang et al., (2022) said that Isometric training involves increasing muscle tension against a fixed resistance, which strengthens the neck muscles and the tension of surrounding soft tissues with minimal or no movement of the bones. This method enhances the stability of the core muscles and the entire neck, thereby improving cervical function and reducing dysfunction and hereby, concluded Isometric training has significant effects on relieving neck pain, improving neck dysfunction, and improving joint mobility. [13]

According to Aikaterini Evangelia Matsi et al., (2019) concluded that Use of the craniocervical flexion exercise with the pressure biofeedback unit has a positive impact on pain, disability, and cervical range of motion in patients with neck pain. [14]

In the study conducted on school teachers by Zaheen A. Iqbal et al., (2021) conveyed that Biofeedback training engages patients in goal-oriented activities, which can enhance motor behavior through reinforcement. Training the deep cervical flexor (DCF) muscles using pressure biofeedback offers external feedback on task performance. Studies have shown that auditory and visual feedback enable individuals to regulate the activation and firing of motor units effectively. [15]

According to Carol GT Vance et al. (2014) conveyed that Transcutaneous electrical nerve stimulation (TENS) is a nonpharmacological intervention that activates a complex neuronal network to reduce pain by activating descending inhibitory systems in the central nervous system. [16] The findings suggest that incorporating pressure biofeedback neck exercises into the rehabilitation programs for cervical spondylosis patients could yield better outcomes compared to isometric exercises alone

In our study Patients performed pressure biofeedback exercises along with TENS group experienced a greater reduction in neck pain compared to those performing isometric exercises along with TENS. A study done by Georgios Tsiringakis strongly supports the finding of our study in which pressure biofeedback exercises attributed to the precise control and feedback provided by the biofeedback device, which allows for more targeted activation of the deep cervical flexors and extensors. Enhanced muscle activation likely leads to better stabilization of the cervical spine, reducing pain more effectively.

Functional status, measured by the Neck Disability Index (NDI), improved in both groups, yet the biofeedback group exhibited more pronounced enhancements. This aligns with the pain reduction, as less pain and increased mobility likely contribute to better overall function. The real-time feedback provided by the pressure biofeedback device may also enhance patient engagement and adherence to the exercise program, further supporting functional improvement.

V. Conclusion

3 weeks of training, reflected that Pressure Biofeedback along with TENS is more effective in relieving pain andimproving function as compared to Isometric along with TENS in case of Cervical Spondylosis.

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